

Chapter 4

Emissions Inventory Development

The toxic emissions inventory for MATES II consists of three components: (1) On-Road Mobile Sources; (2) Area and Off-Road Mobile Sources; and (3) Major Point Sources and AB2588 Sources. The following is the description of how each portion of the inventory was developed. More than 100 toxic compounds have been incorporated into the emissions inventory. In the following sections, only the high-risk compounds (as determined by their unit risk numbers and presented in Table 4.1) are presented.

4.1 On-Road Mobile Sources

On-Road Mobile Sources include cars, trucks, buses and motorcycles. The on-road mobile source emissions inventory is a product of: ARB's EMFAC7G emissions factors for 1998, developed by ARB; an interpolation of SCAG's transportation model between 1994 and 2000 for vehicle miles traveled (VMT) and speed corrections; and distribution of emissions using Cal Trans/ARB's model called DTIM2 to 2x2 km grids.

The above process produces the emissions inventory for criteria pollutants (VOC, NO_x, PM, CO, SO_x). Toxic compound emissions inventory is obtained by applying latest ARB speciation profiles to the VOC and PM emissions.

The diesel particle emissions are of special interest to this study since the California EPA has classified the particle portion of diesel exhaust (from internal combustion engines) as a toxic air contaminant. ~~These emissions are classified as PM emissions with profile codes 425 and 116, and~~ The method chosen to identify diesel particulate uses the referenced particulate speciation profile. Upon reviewing the set of particulate profiles available from the ARB, only two profiles were identified as internal combustion engines burning diesel fuel. The profile numbers and titles are as follows:

116 – Stationary Internal Combustion Engine – Diesel

425 – Diesel Vehicle Exhaust

Source categories referencing these two profiles are assumed to be sources of diesel particulate. As shown in Table 4-2 and 4-3 diesel particulate emissions are primarily generated by on-road diesel engines, off-road diesel engines, trains, motor ships, and commercial diesel boats.

4.2 Stationary Point Sources

The SCAQMD maintains two major emissions data banks: (1) The Annual Emissions Reporting (AER) system, containing emissions information on criteria

pollutants and some toxic compounds; and (2) The Toxic Hot Spot (AB2588) program containing emissions information on numerous toxic compounds. For the MATES II project, a contractor was hired to update the emissions inventory of major toxic compounds by utilizing the existing information, augmented by special studies. The following steps were taken in developing the stationary point source toxic emissions inventory:

1. The AB2588 database was updated by conducting a survey of top emitters. The non-surveyed facilities' emissions were updated by applying growth factors to adjust for economic changes from the early 1990s to 1998. Appropriate control factors were applied to sources whose emissions have been reduced due to existing rules and regulations.
2. The non-AB2588 facilities' emissions were analyzed by utilizing the 1997 AQMP point source inventory. This data bank contains information on criteria pollutants such as particulate matter (PM) and volatile organic compounds (VOC). Appropriate PM or VOC speciation profiles were applied to these emissions in order to obtain specific toxic compound emissions. Appropriate growth and control factors were applied to the 1993 data to reflect 1998 conditions. In addition, several larger sources were reviewed to determine if their emissions are correctly projected to 1998.

4.3 Area and Off-Road Sources

Area and off-road sources represent numerous small sources of emissions that can collectively have significant emissions and can contribute to high risks. Examples of area sources are: dry cleaners, gasoline stations, auto body shops, and chrome platers. Examples of off-road sources are: construction equipment, motor boats and airplanes. Area source emissions are distributed throughout the modeling domain using surrogates such as population, retail and non-retail sales, or employment. For the MATES II study, appropriate growth and control factors were applied to the 1993 area and off-road source emissions to reflect 1998 conditions. Three area sources, namely dry cleaners, gasoline stations and chrome platers, were spatially distributed using surrogates as discussed below.

Perchloroethylene Dry Cleaning

Perchloroethylene dry cleaning countywide emissions were apportioned according to the permitted annual emissions and located at their specific address. The perchloroethylene dry cleaning emissions were derived from California import and domestic-production records. Total perchloroethylene emissions were approximately 6.6 tons per day and distributed over 1,300 facilities in SCAB.

Retail Gasoline Dispensing

The retail gasoline dispensing countywide emissions were apportioned according to the permitted annual emissions and located at their specific address. The retail gasoline dispensing emissions were derived from gasoline shipping and taxable sales records. Retail gasoline dispensing emissions of approximately 18 tons per day were distributed over 2,970 facilities in SCAB.

Hexavalent Chromium Plating

The AB2588 program contains the larger chromium plating facilities. There are approximately 74 plating facilities in the AB2588 program. In addition, there are approximately 84 aerospace facilities that may do plating in the AB2588 program. The facility counts are rough approximations because some of the plating facilities may not use (and thereby emit) chromium (specifically, hexavalent chromium). (Some aerospace companies contract out their plating needs, and some facilities that do chromium plating do not belong to specific emission source categories.)

To augment the AB2588 facility list, a search was performed to identify the smaller chromium plating facilities. Small chromium plating facilities were then represented by calculated annual emissions, and located at their specific address. Four types of sources were identified: hard chrome plating tanks, decorative chrome plating tanks, chrome anodizing tanks, and spray booths. Through the aforementioned process, 87 smaller chromium facilities were identified, assigned emissions, and added to the MATES II modeling inventory.

4.4 Summary of Toxic Emissions

Table 4-2 presents the emissions from selected compounds by source category. Figures 4-1 and 4-2 present the weighted emissions by the compounds' unit risk factor (URF). [Table 4-3 presents the toxic emissions categorized by major source categories.](#) Diesel emissions account for 80 percent of the overall cancer risk as shown in Figure 4-1. The other significant compounds are 1,3 butadiene, benzene, and hexavalent chromium. The on-road and off-road mobile sources contribute to the majority of the risks as shown in Figure 4-2. Figures 4-3 through 4-5 show the spatial distribution of the location of emissions for dry cleaners, gasoline stations, and chrome platers. Figures 4-6 through 4-10 show the spatial distribution of emissions for diesel particles, benzene, 1,3 butadiene, perchloroethylene, and hexavalent chromium, respectively.

Table 4-1

**List of MATES II
Emissions Inventory Compounds**

COMPOUNDS	PROBABLE EXAMPLES OF TYPE OF OPERATION
1,1 dichloroethane	landfill-flare, fugitive
1,3 butadiene	mobile sources; petroleum industry
acetaldehyde	combustion equipment
acetone*	solvent use; degreasing
arsenic	oil-fired equipment; flare; incinerator
benzene	mobile sources; petroleum industry
cadmium	plating operation; incinerator
carbon tetrachloride	solvent use; degreasing; coating
chloroform	coating
chloromethane/methyl chloride	printing; laboratory
diesel exhaust	diesel engines
1,4 dioxane	degreasing operation
elemental carbon	diesel exhaust; fugitive dust
ethylene dibromide	flare; incinerator
ethylene dichloride	flare; incinerator
ethylene oxide	sterilizer
formaldehyde	mobile sources; combustion equipment
hex chrome	plating operation
lead	flare; battery manufacturing; lead smelting
MEK	solvent use; degreasing
methylene chloride/dichloromethane	degreasing operation; coating
MTBE	gasoline consumption; mobile sources
nickel	plating operation; incinerator
organic carbon	diesel exhaust; charbroilers
para dichlorobenzene	consumer products, pesticide and herbicide mfg.
perc	dry cleaning; solvent use; degreasing; film cleaning
propylene oxide	chemical manufacturing
selenium	oil-fired equipment; flare; incinerator
silicon*	sand blasting
styrene	foam blowing
toluene	petroleum operation; solvent use; degreasing; coating
total chromium	oil-fired equipment; coating; incinerator
trichloroethylene	degreasing operation; coating; solvent use
vinyl chloride	incinerator

*Not toxic compounds: Emissions listed for evaluating model performance

Table 4-2

Annual Average Day Emissions for the South Coast Air Basin

Pollutant	Emissions (lbs/day)					
	On-Road	Off-Road	Point	AB2588	Area	Total
Acetaldehyde*	5485.8	5770.3	33.9	57.1	189.1	11536.2
Acetone**	4945.8	4824.7	3543.5	531.4	23447.4	37292.8
Benzene	21945.5	6533.4	217.7	266.8	2495.4	31458.8
Butadiene [1,3]	4033.8	1566.1	6.7	2.0	151.3	5759.9
Carbon tetrachloride	0.0	0.0	8.8	1.8	0.0	10.6
Chloroform	0.0	0.0	0.0	35.5	0.0	35.5
Dichloroethane [1,1]	0.0	0.0	0.0	0.1	0.0	0.1
Dioxane [1,4]	0.0	0.0	0.0	105.0	0.0	105.0
Ethylene dibromide	0.0	0.0	0.0	0.2	0.0	0.2
Ethylene dichloride	0.0	0.0	4.9	17.6	0.0	22.5
Ethylene oxide	0.0	0.0	58.1	12.3	454.1	524.4
Formaldehyde*	16664.9	16499.3	521.6	674.7	1107.5	35468.0
Methyl ethyl ketone*	905.1	906.9	3240.2	385.9	14535.4	19973.5
Methylene chloride	0.0	0.0	1378.6	1673.6	9421.7	12473.9
MTBE	58428.9	2679.2	40.5	434.4	5473.7	67056.7
p-Dichlorobenzene	0.0	0.0	0.0	4.5	3735.6	3740.1
Perchloroethylene	0.0	0.0	4622.0	2249.1	22813.1	29684.2
Propylene oxide	0.0	0.0	0.0	22.3	0.0	22.3
Styrene	1114.8	287.1	447.0	3836.7	21.4	5707.0
Toluene	63187.6	11085.9	5689.6	3682.4	52246.7	135892.2
Trichloroethylene	0.0	0.0	1.1	58.0	2550.3	2609.3
Vinyl chloride	0.0	0.0	0.0	4.3	0.0	4.3
Arsenic	0.1	0.3	2.7	0.7	21.4	25.2
Cadmium	1.6	1.5	0.5	0.7	27.5	31.8
Chromium	2.4	2.3	3.9	2.2	302.2	313.0
Diesel particulate	23906.3	22386.3	0.0	5.4	815.3	47113.4
Elemental carbon***	27572.1	6690.3	702.8	0.0	16770.5	51735.7
Hexavalent chromium	0.4	0.4	0.3	1.0	0.1	2.2
Lead	0.7	0.9	1.9	24.5	1016.3	1044.3
Nickel	2.5	2.2	2.9	21.6	85.6	114.9
Organic carbon	16426.2	15381.8	0.0	0.0	108612.1	140420.2
Selenium	0.1	0.1	3.0	5.7	2.6	11.6
Silicon**	68.6	67.6	167.2	0.0	248614.0	248917.4

* Primarily emitted emissions. These materials are also formed in the atmosphere as a result of photochemical reactions.

** Acetone and silicon are not toxic compounds. Their emissions are included here because they were measured in the sampling program and were subsequently modeled for the purpose of model evaluation.

*** Includes elemental carbon from all sources (including diesel particulate).

Table 4-3. 1998 Toxics Emissions (lbs/day) by Major Source Category for the South Coast Air Basin.

Code	Source Category	Benzene	1,3 Butadiene	p-Dichloro- benzene	Methylene chloride	Perchloro- ethylene	Trichloro- ethylene	Formalde- hyde	Acetalde- hyde	Diesel PM	Hex. chromium	Nickel
100	Fuel Combustion											
110	Agricultural	1.42	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.02	0.01
120	Oil and Gas Production	55.57	0.02	0.00	0.00	0.00	0.00	121.01	1.10	0.00	0.02	0.01
130	Petroleum Refining	1.12	0.01	0.00	0.00	0.00	0.00	2.44	0.12	0.00	0.01	0.03
140	Other Manufacturing/Industrial	150.93	3.48	0.00	0.00	0.00	0.00	598.79	109.87	815.34	0.10	0.24
150	Electric Utilities	12.63	0.04	0.00	0.00	0.00	0.00	31.58	0.41	0.00	0.01	0.28
160	Other Service and Commerce	94.48	3.82	0.00	0.00	0.00	0.00	255.41	17.76	0.00	0.14	0.18
170	Residential	171.61	0.00	0.00	0.00	0.00	0.00	437.33	85.34	0.00	0.02	0.01
199	Other	11.19	1.80	0.00	0.00	0.00	0.00	32.26	8.44	0.00	0.06	0.05
	Total	498.96	9.16	0.00	0.00	0.00	0.00	1478.97	223.04	815.34	0.36	0.81
200	Waste Burning											
210	Agricultural Debris	0.00	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
220	Range Management	0.00	13.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
230	Forest Management	0.00	135.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
240	Incineration	1.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
299	Other	0.00	0.00	0.00	0.00	0.00	0.00	9.53	0.00	0.00	0.00	0.00
	Total	1.39	148.84	0.00	0.00	0.00	0.00	9.53	0.00	0.00	0.00	0.01
300	Solvent Use											
310	Dry Cleaning	0.00	0.00	0.00	0.00	16106.30	0.00	0.00	0.00	0.00	0.00	0.00
320	Degreasing	0.00	0.00	0.00	8056.99	8594.22	2551.34	0.00	0.00	0.00	0.00	0.00
330	Architectural Coating	115.48	0.00	0.00	2117.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
340	Other Surface Coating	10.16	0.00	0.00	186.32	0.00	0.00	30.14	0.00	0.00	0.00	0.00
350	Asphalt Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
360	Printing	0.00	0.00	0.00	0.00	0.00	0.00	8.77	0.00	0.00	0.00	0.00
370	Consumer Products	0.00	0.00	3531.72	409.76	1034.15	0.00	58.54	0.00	0.00	0.00	0.00
380	Industrial Solvent Use	0.11	0.00	0.00	0.00	569.43	0.00	0.00	0.00	0.00	0.00	0.00
399	Other	8.74	0.00	0.00	0.00	351.78	0.00	0.00	0.00	0.00	0.00	0.00
	Total	134.49	0.00	3531.72	10770.55	26655.87	2551.34	97.44	0.00	0.00	0.00	0.00
400	Petroleum Process, Storage & Transfer											
410	Oil and Gas Extraction	318.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
420	Petroleum Refining	2.44	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
430	Petroleum Marketing	205.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
499	Other	8.78	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
Total	Petroleum Process, Storage & Transfer	534.63	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00

(continued)

Table 4-3. Continued.

Code	Source Category	Benzene	1,3 Butadiene	p-Dichloro- benzene	Methylene chloride	Perchloro ethylene	Trichloro ethylene	Formalde hyde	Acetalde hyde	Diesel PM	Hex. chromium	Nickel
500	Industrial Processes											
510	Chemical	0.00	0.00	0.00	0.00	0.00	0.00	37.81	0.00	0.00	0.00	0.30
520	Food and Agricultural	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
560	Mineral Processes	0.52	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.04	0.22
570	Metal Processes	0.00	0.00	0.00	0.00	0.00	0.00	1.64	0.00	0.00	0.04	1.88
580	Wood and Paper	0.06	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00
599	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	0.58	0.00	0.00	0.00	0.00	0.00	39.66	0.00	0.00	0.09	2.40
600	Miscellaneous Processes											
610	Pesticide Application	1542.93	0.00	203.92	23.66	59.71	0.00	3.38	0.00	0.00	0.00	0.00
620	Farming Operations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.72
630	Construction and Demolition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.33
640	Entrained Road Dust - Paved	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.48
650	Entrained Road Dust - Unpaved	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.83
660	Unplanned Fires	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
670	Fugitive Windblown Dust	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.33
680	Waste Disposal	0.00	0.00	0.00	0.00	719.51	0.00	0.00	0.00	0.00	0.00	0.59
685	Natural Sources	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
690	NOx/SOx RECLAIM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
691	ERC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
692	Hi/LO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
693	NSR Exemption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
694	Rule 518.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
695	ODC Conversion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
699	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	1542.93	0.00	203.92	23.66	779.22	0.00	3.38	0.00	0.00	0.00	85.29
700	On-Road Vehicles											
710	Light-Duty Passenger	14133.12	2582.24	0.00	0.00	0.00	0.00	6922.97	1610.57	674.52	0.20	1.14
720	Light- and Medium-Duty Trucks	6204.22	1224.73	0.00	0.00	0.00	0.00	3104.16	698.20	346.85	0.09	0.50
730	Heavy-Duty Gas Trucks	522.93	86.42	0.00	0.00	0.00	0.00	303.18	63.13	0.00	0.08	0.46
740	Heavy-Duty Diesel Trucks	808.48	76.77	0.00	0.00	0.00	0.00	5945.02	2970.89	22769.86	0.00	0.36
750	Motorcycles	250.89	61.20	0.00	0.00	0.00	0.00	199.09	47.84	0.00	0.01	0.06
760	Heavy-Duty Diesel - Urban Bus	25.90	2.46	0.00	0.00	0.00	0.00	190.44	95.17	115.07	0.00	0.00
799	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	21945.53	4033.82	0.00	0.00	0.00	0.00	16664.85	5485.80	23906.30	0.39	2.52

(continued)

**Table 4-3.
Concluded.**

Code	Source Category	Benzene	1,3 Butadiene	p-Dichloro- benzene	Methylene chloride	Perchloro- ethylene	Trichloro- ethylene	Formalde- hyde	Acetalde- hyde	Diesel PM	Hex. chromium	Nickel
800	Other Mobile											
810	Off-Road Vehicles	2886.70	695.27	0.00	0.00	0.00	0.00	2672.39	658.44	95.34	0.24	1.35
815	Commercial Boats	38.03	4.84	0.00	0.00	0.00	0.00	225.57	110.75	200.00	0.00	0.00
820	Trains	83.06	7.89	0.00	0.00	0.00	0.00	610.76	305.21	1053.15	0.00	0.02
830	Ships	191.17	16.81	0.00	0.00	0.00	0.00	1302.49	650.57	5176.44	0.00	0.08
850	Aircraft - Government	13.92	3.36	0.00	0.00	0.00	0.00	10.66	4.24	0.00	0.00	0.00
860	Aircraft - Other	474.73	269.57	0.00	0.00	0.00	0.00	1974.94	627.28	0.00	0.04	0.05
870	Mobile Equipment	1849.63	328.02	0.00	0.00	0.00	0.00	8799.08	3196.60	15861.37	0.02	0.38
880	Utility Equipment	996.13	240.35	0.00	0.00	0.00	0.00	903.47	217.18	0.00	0.06	0.33
891	Seeps/Biogenics	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
892	Channel Shipping	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
893	OCS and Related Sources	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
894	Tideland Platforms	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	6533.38	1566.10	0.00	0.00	0.00	0.00	16499.34	5770.27	22386.30	0.37	2.21
900	Unspecified Sources	0.06	0.01	0.00	6.09	0.00	0.00	0.05	0.01	0.00	0.00	0.00
	AB 2588 Sources	266.81	2.01	4.48	1673.60	2249.10	57.99	674.73	57.11	5.42	1.00	21.63
Total	Stationary and Area Sources	2979.85	160.02	3740.12	12473.90	29684.20	2609.33	2303.81	280.17	820.76	1.45	110.14
Total	On-Road Vehicles	21945.53	4033.82	0.00	0.00	0.00	0.00	16664.85	5485.80	23906.30	0.39	2.52
Total	Other Mobile	6533.38	1566.10	0.00	0.00	0.00	0.00	16499.34	5770.27	22386.30	0.37	2.21
Grand	Total	31458.76	5759.93	3740.12	12473.90	29684.20	2609.33	35468.00	11536.23	47113.37	2.20	114.88

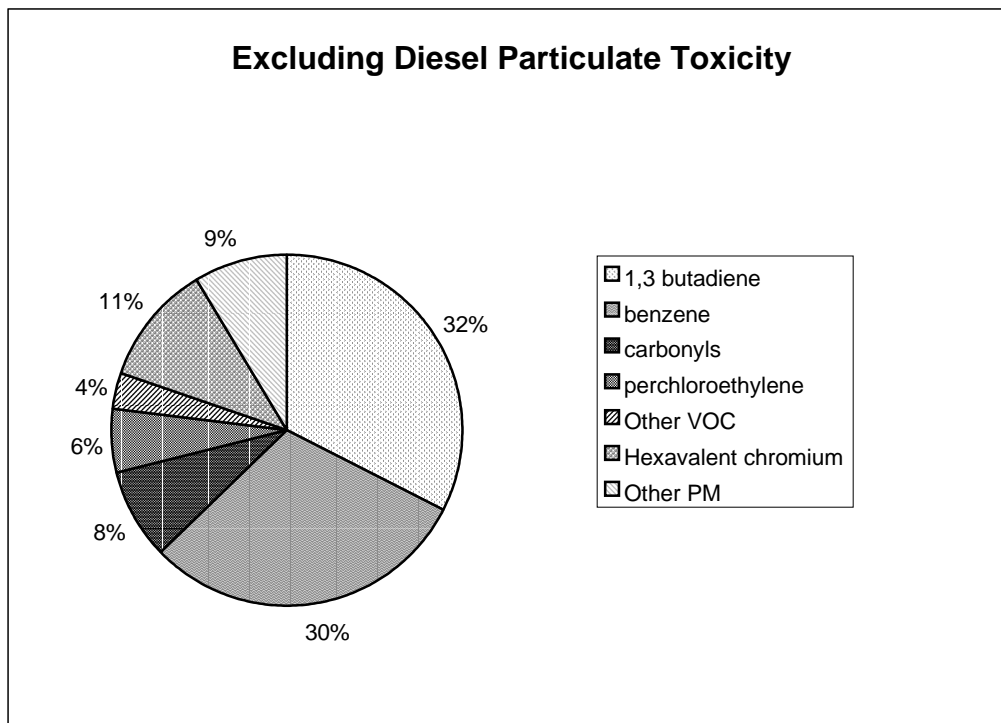
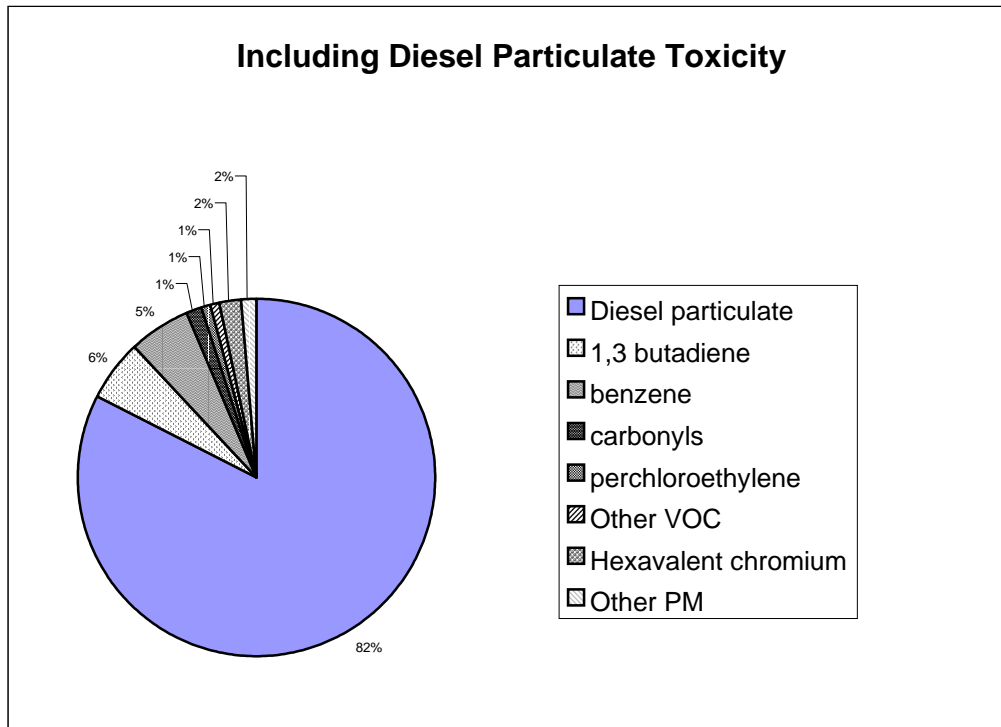


Figure 4-1. Species apportionment using toxicity-weighted emissions.

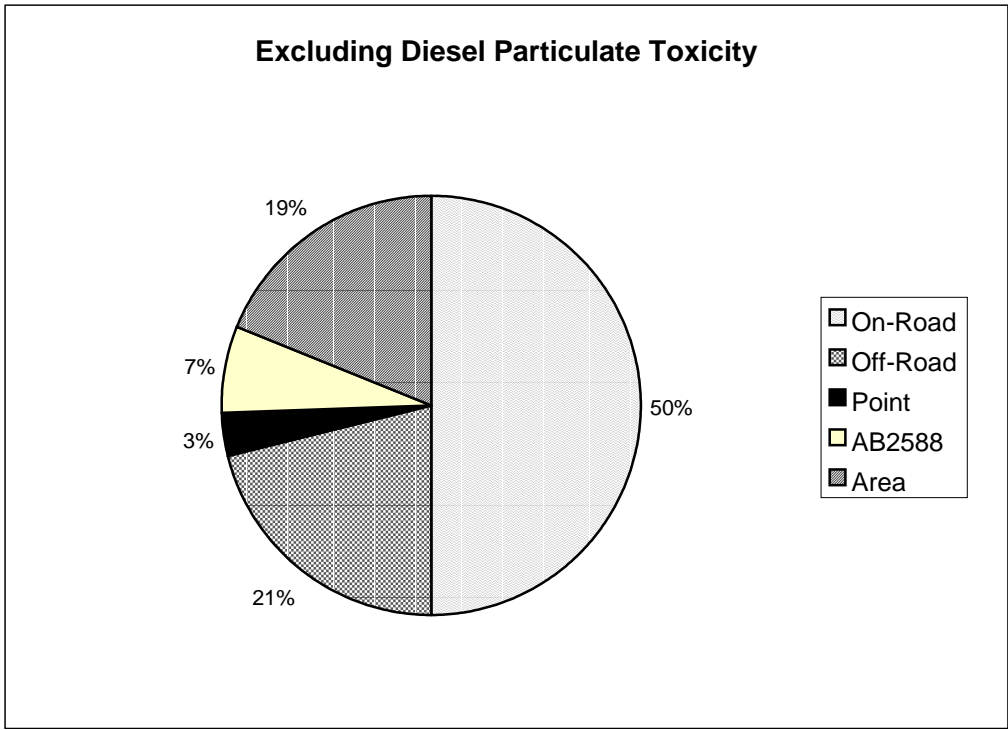
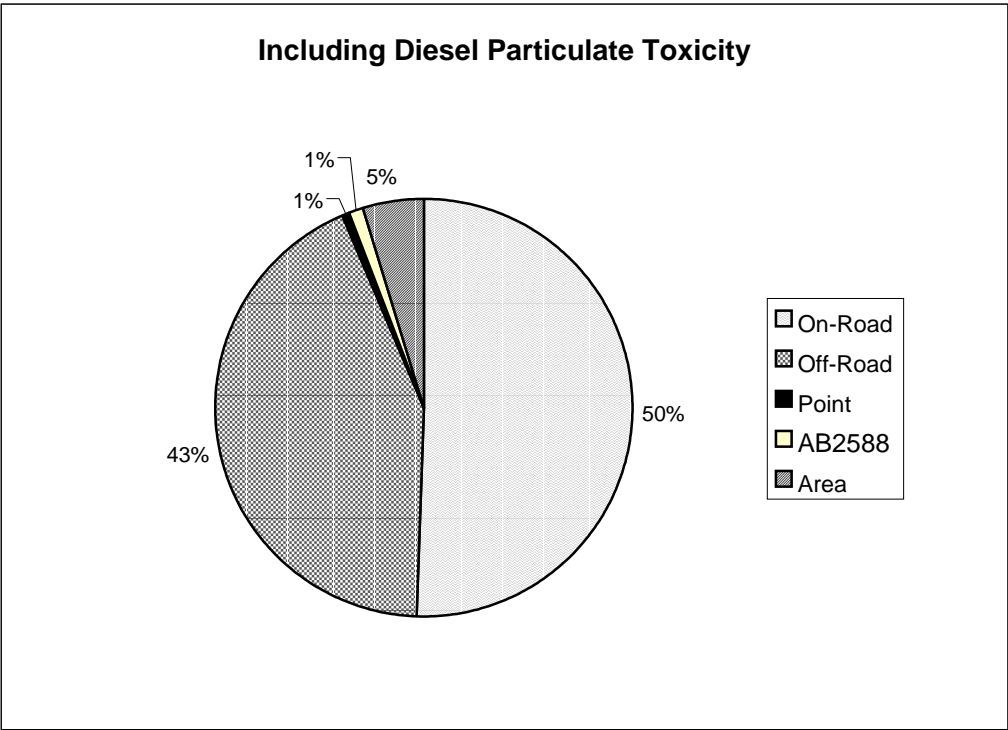


Figure 4-2. Source apportionment using toxicity-weighted emissions.

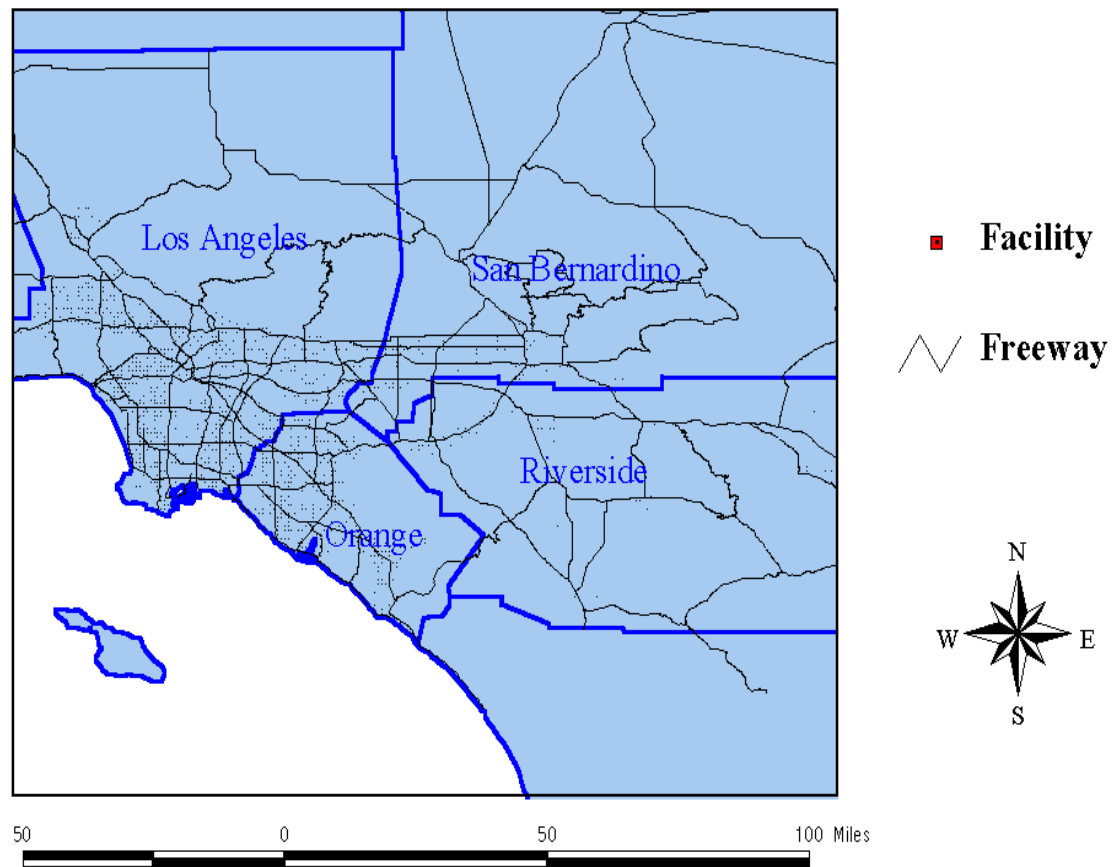


Figure 4.3 Spatial Distribution of Dry Cleaners

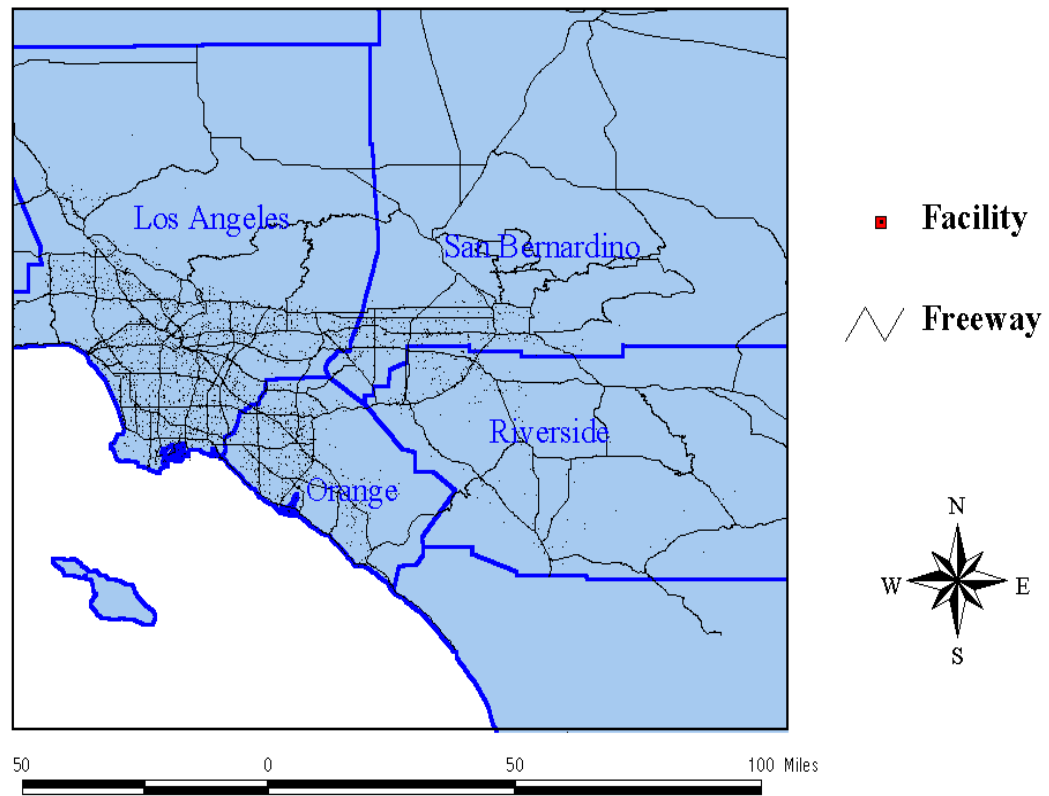


Figure 4.4 Spatial Distribution of Gas Stations

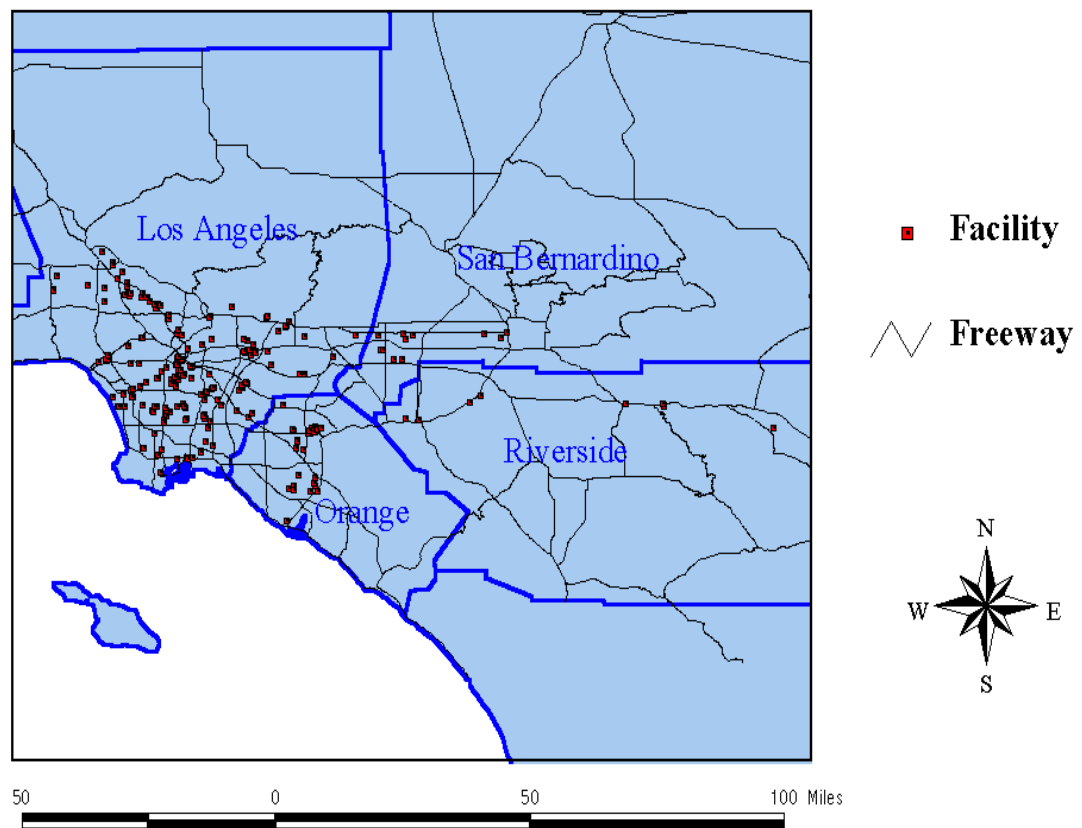


Figure 4.5 Spatial Distribution of Chrome Plating Facilities

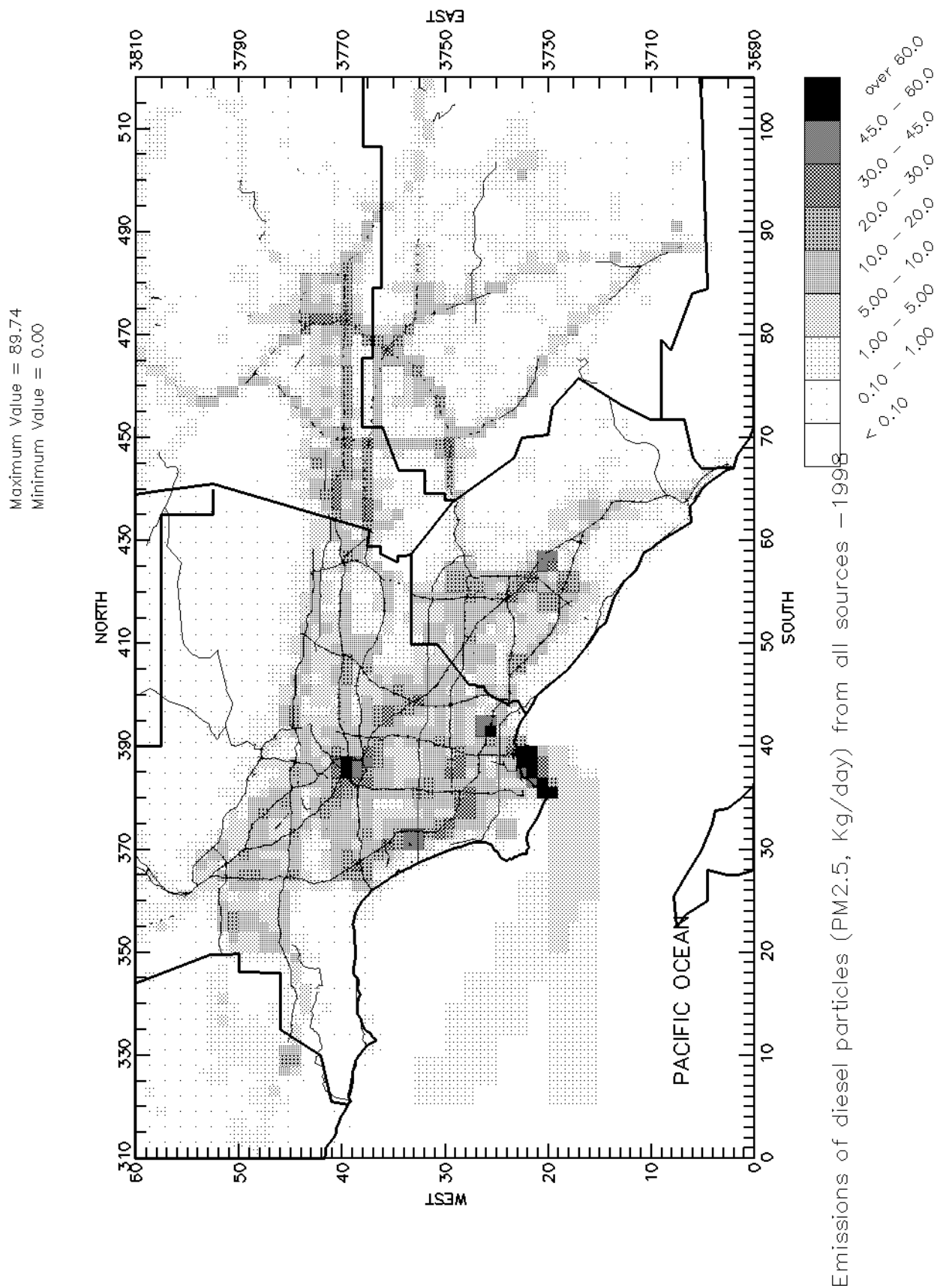


Figure 4-6

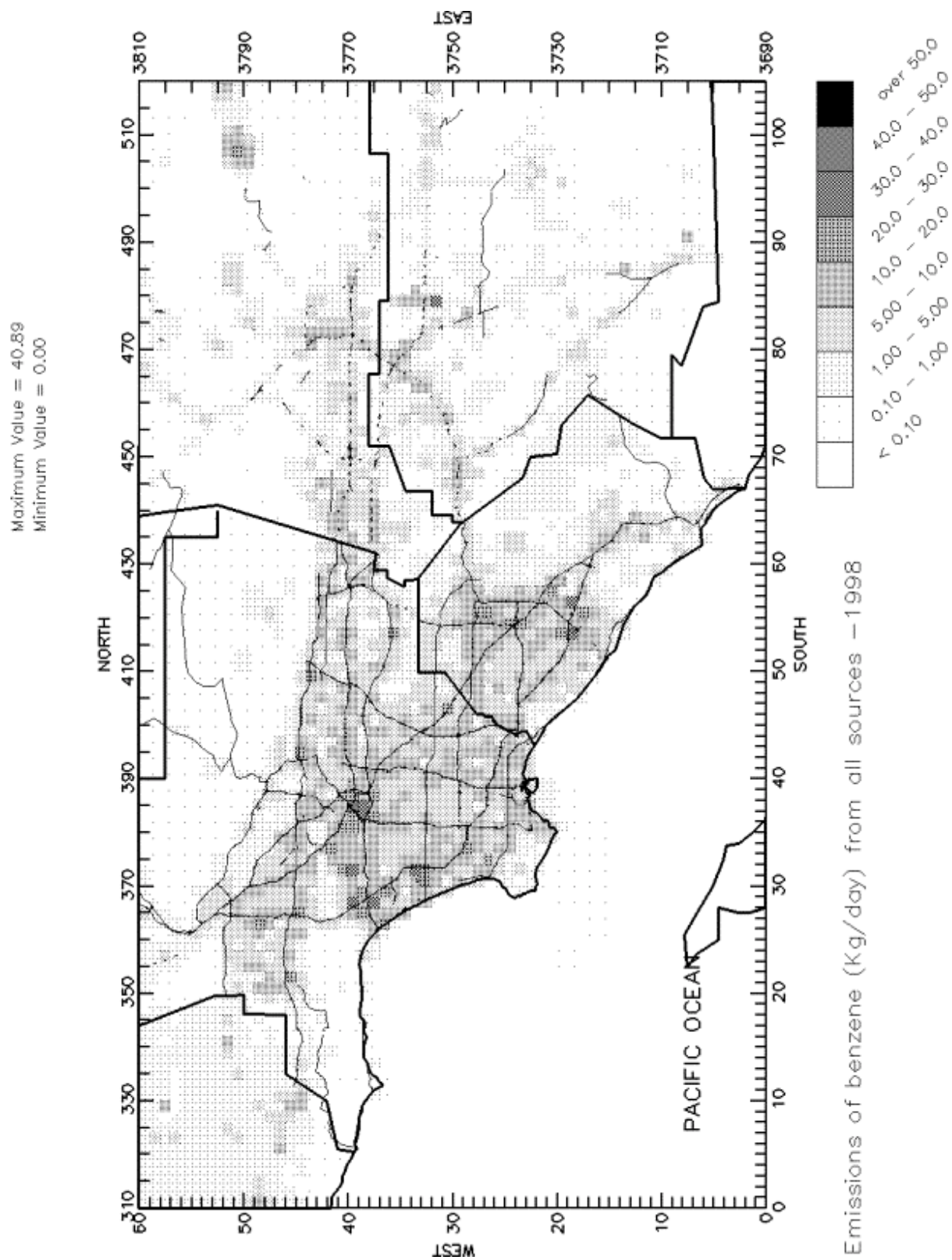


Figure 4-7

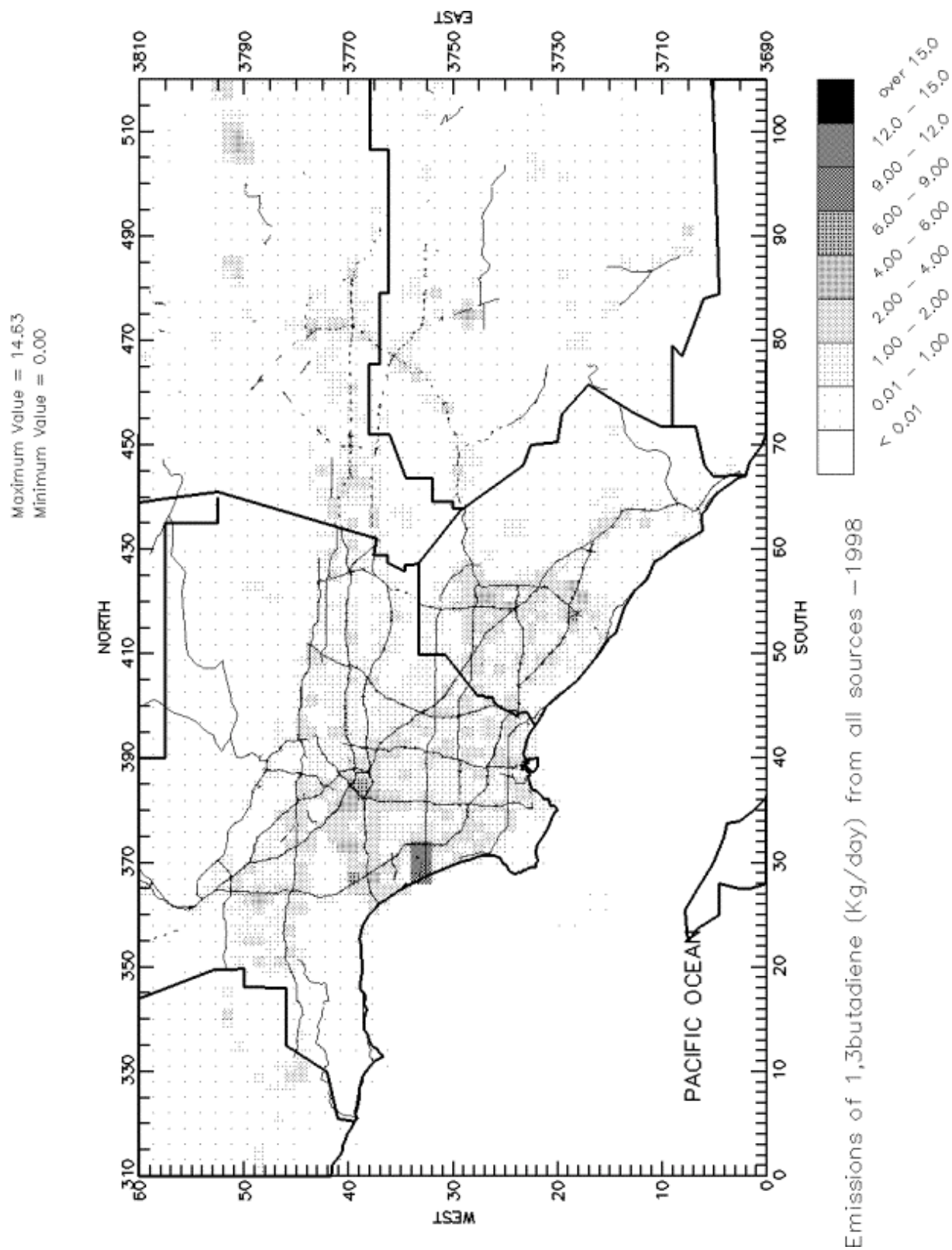


Figure 4-8

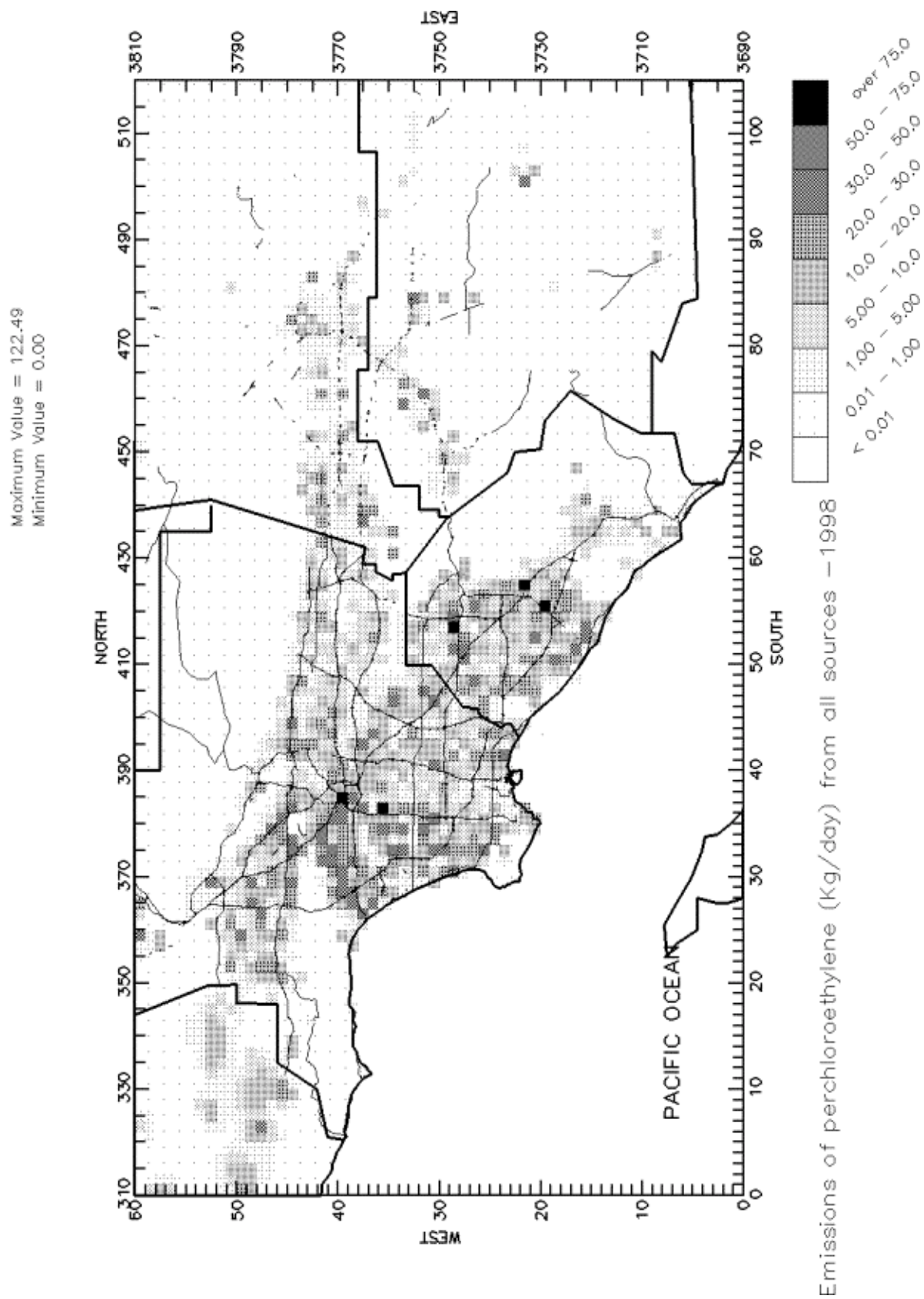


Figure 4-9

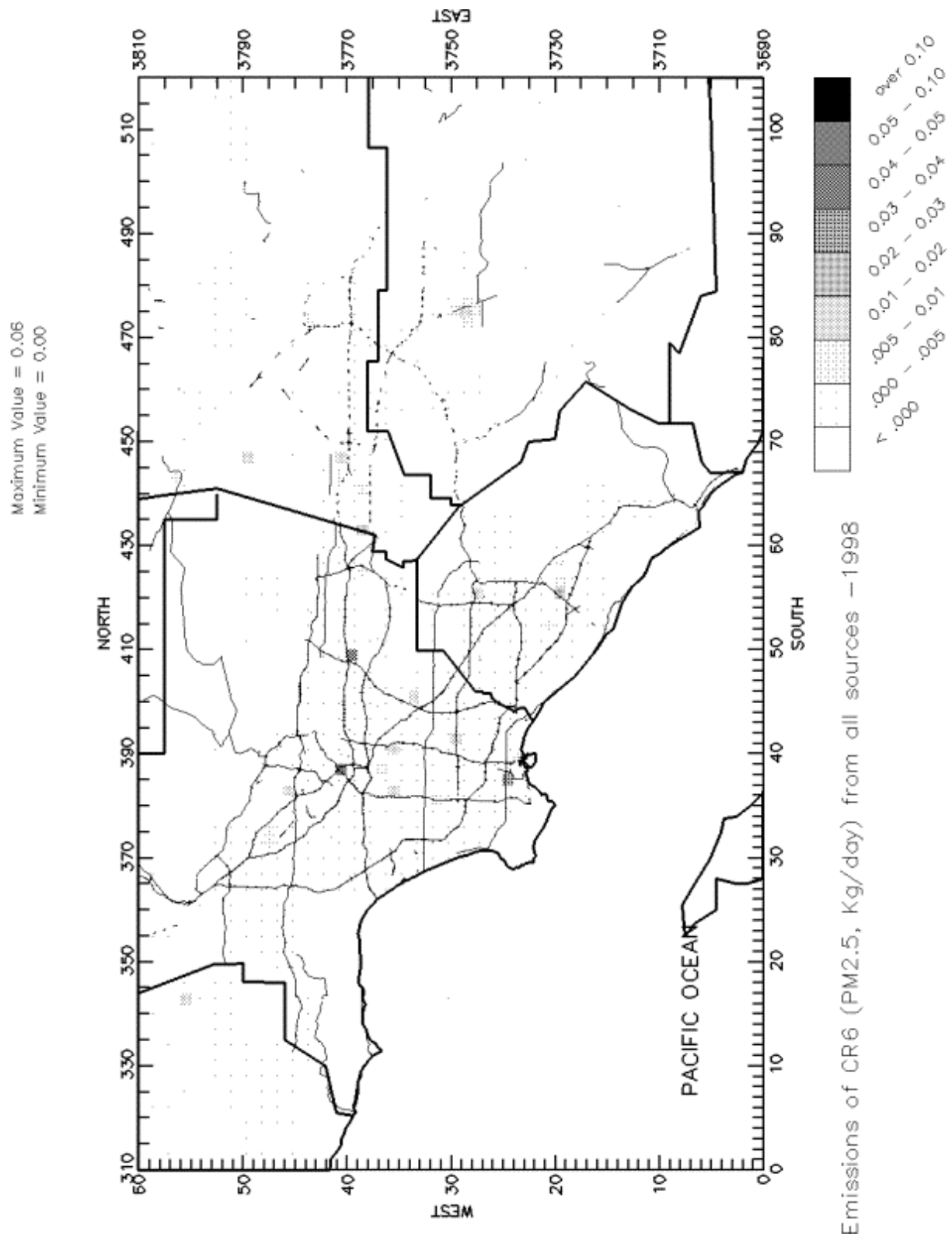


Figure 4-10